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Understanding Sustainability-oriented Innovation (SOI) Using Network Perspective in Asia Pacific and ASEAN: A Systematic Review

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Abstract

Sustainability-oriented innovation (SOI) is particular type of innovation that is not only economically oriented, but also environmental- and social benefits-oriented. SOI is now being widely discussed due to the increasing environmental and social problems that accompany various innovations around the world. In this paper we conducted a systematic review of empirical literature regarding SOI in the Asia Pacific region, which were discussed through network perspectives. For network perspectives, researchers focused on process view to explain how SOI is mobilized and practiced throughout different social, institutional, and political contexts. We chose the Asia Pacific as the context because the region is the most dynamic part of the global economy, with ASEAN being the prominent parts of it. In conducting the review, we used the Tranfield, Denyer, & Smart's protocol (2003) to ensure its rigorousness. The search focused on the academic database of Scopus with specific inclusion and exclusion criteria. The results show that SOI has been rapidly developing into practices in countries in the Asia Pacific, not only in profit sectors, but also in non-profit sectors such as government and community. Our review emphasized that actor-network theory (ANT) emerged as the currently most adopted framework to explain the dynamics process of SOI mobilizations and practices in the Asia Pacific region. ANT frameworks contribute to defining the structure of SOI networks as well as identifying social, institutional, and political challenges of SOI implementation. Regionally, the focus of the study so far is in North America (US and Canada), while studies in ASEAN are still very limited.

Key Words*: sustainability-oriented innovation, actor network perspective, actor-network theory, Asia Pacific, ASEAN*

Introduction

Innovation with orientation not only toward financial returns, but also paying attention to environmental and social benefits has recently been widely discussed by researchers, industry players, as well as policy makers. This particular type of innovation is known as sustainability-oriented innovation (SOI). Academically, in the last decade, the study of SOI has rapidly increased, marked with a graph of significant peer-reviewed publications in the field (Adams, Jeanrenaud, Bessant, Denyer, & Overy,

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2016; De Medeiros, Ribeiro, & Cortimiglia, 2014). For the industry, this challenge facing managers is to be successful in the modern world that requires companies to be sustainable. This, for example, can be seen in market research, which reports that consumers now prefer to buy from innovative and sustainable brands, and managers consider environmental and social aspects when developing new products (McKinsey & Vanthournout, 2008; Unilever, 2017). For policy makers, various indices that measure innovation and sustainability, such as Global Innovation Index (Cornell University, INSEAD, & WIPO, 2018) and Country Sustainability Ranking (RobecoSAM, 2018) become benchmarks to be able to improve the conditions of innovation and sustainability within the scope of their socio-economic and ecological ecosystem.

SOI is a process that is temporal and relational, and involves various stakeholders interacting each other (Kadia Georges Aka, 2019). Consequently, the process view through network perspective is essential to elaborate these complex phenomena comprehensively (Whiteman & Kennedy, 2016). Network perspective that analyses the network to develop SOI effort, including actor-network theory (ANT), is considered to be the suitable approach to explore the temporal and relational nature of SOI development (Garud, Gehman, Kumaraswamy, & Tuertscher, 2017). Although important, studies with this approach are still limited and have only recently emerged (Xavier, Naveiro, Aoussat, & Reyes, 2017). This paper aims to understand development of SOI using network perspective through systematic review of the literature in the academic database. The Asia Pacific region become the focus considering that this region is economically playing a role as the most dynamic region in the world, with ASEAN being the prominent parts of it. (IMF, 2018; Yates & Beeson, 2019).

Sustainability-oriented innovation (SOI) and Network Perspective

SOI is a combination of two main areas that have already been established, namely eco-innovation and social innovation (Hansen & Große-Dunker, 2013). A more comprehensive discussion lately, among others have called it as SOI, sustainability innovation or sustainability-driven innovation or sustainability-related innovation. In the business context, SOI gets attention regarding the increasing concern of consumers, regulators, and other stakeholders that require companies to act more responsibly in their innovations. This issue is now a strategic issue that can lead companies not only to compliance with the regulation, but also to use them strategically as opportunities to improve company reputation, reduce costs, and obtain better overall financial returns (Ghisetti & Rennings, 2014). This type of SOI as conventional innovation can be divided into product, process, and organizational innovation.

In its development, SOI is not only relevant to business organizations, but also non-profit organizations such as community, village, educational institutions, government, city, or region. This can happen by adopting the SOI

framework which is in the form of innovation by targeting three economic, environmental, and social aspects simultaneously. In the context of rural or village development, for example, SOI is implemented in the form of social innovation with the formation of intermediaries to facilitate the optimization of relations between stakeholders in the community (Martiskainen, 2017). For university, this initiative for example is realized by connecting multi-players including producers, R & D, societal groups, user groups, and public authorities to be able to effectively link the problem environment and social (Morioka, Saito, & Yabar, 2006).

Academic interests towards various discussions of complexities of the emergent and dynamic nature of intervention-based projects, in which the SOI projects are a part of it, have increasingly popular in the current periods (Sage, Dainty, & Brookes, 2011). Such complexities are generally emphasized as 'network complexities' or processes involving compositions and changes of the networks structuring the projects (Boonstra & Boelens, 2011; Byrne, 2003; De Roo & Silva, 2010). The most common discussed topic around 'network complexities' of projects appeared in the understanding of various projects as a product of interactions between different actors with their values, strategies, and many other characteristics in the process (P. C. Chen & Hung, 2016). Second other most discussed topic is the identification of how such projects are mobilized, changed, progressed, and challenged through the dynamic assembling and disassembling of the involved actors within a project network (Albrecht, 2013). Other academics have been even going further recently by comparing 'network complexities' of a number of projects to justify their feasibility, strengths, and weakness (Goulden, Erell, Garb, & Pearlmutter, 2017; Stephens & Jiusto, 2010).

Various theoretical foundations and analytical methods were developed by academics to guide and assist research on network complexities. Such theories and methods are clustered into an umbrella term of 'network studies' (Vicsek, Király, & Kónya, 2016). These contain quantitative and qualitative approaches emphasizing different set of indicators and mechanisms (Boelens, 2010; Caniglia, Frank, Kerner, & Mix, 2016; Farías, 2011; Yvone Rydin & Tate, 2016). For instances, Urban Regime theory containing theories explaining power and political behaviors in a network (Lowndes, 2009), Actor-Network Theory (ANT) containing the ontological and semiotic meanings of the actors in networks (Farías, 2011), Social Network Analysis (SNA) concerning the level of capacity and role of actors in networks (Caniglia et al., 2016), Actor Relational Approach (ARA) focusing on interactive and communicative repertoires of actor networks in specific episodes (Boelens, 2010), and the Agent-based Modelling representing various computational perspectives simulating autonomous

actors in a set of self-organized systems (Batty, 2005).

In wider academic perspectives, ANT-studies have been emerged as one of the most popular 'network studies' applied to draw the understanding of various projects. It is particularly in the Western, mainly in European (Yvone Rydin & Tate, 2016). Pioneered by the likes of Law and Hassard's *Actor Network Theory and After* (1999) and Latour's *Reassembling the Social* (2005), ANT-studies, arguably, penetrated to many subjects beyond sociology as its origin, which include to planning (Yvone Rydin & Tate, 2016), governance and public policy (Albrecht, 2013), management (Sage et al., 2011), environment (Goulden et al., 2017), and architecture (Farías, 2011).

ANT concerns on networks, specifically dynamic networks surrounding social, science and technology related-studies and their intersections (Farías, 2011; Yvonne Rydin, 2012). Having a term 'theory' on its name, does not mean ANT is an actual theory. Instead, it is more suitable to be considered as a flexible and adaptive framework or method (Latour, 2005). The 'actor' in ANT means a flux element constructed by several other elements (Yvonne Rydin, 2012). It refers to both human such as individual in general or in specific roles and non-human such as materials, technologies, machines, policies, and regulations (Sage et al., 2011). The network, on the other hands, is fluid and dynamic relations built by actors, and has characteristics such as unstable, uncertain, and continuously reshaping (Latour, 2005; Yvonne Rydin, 2012).

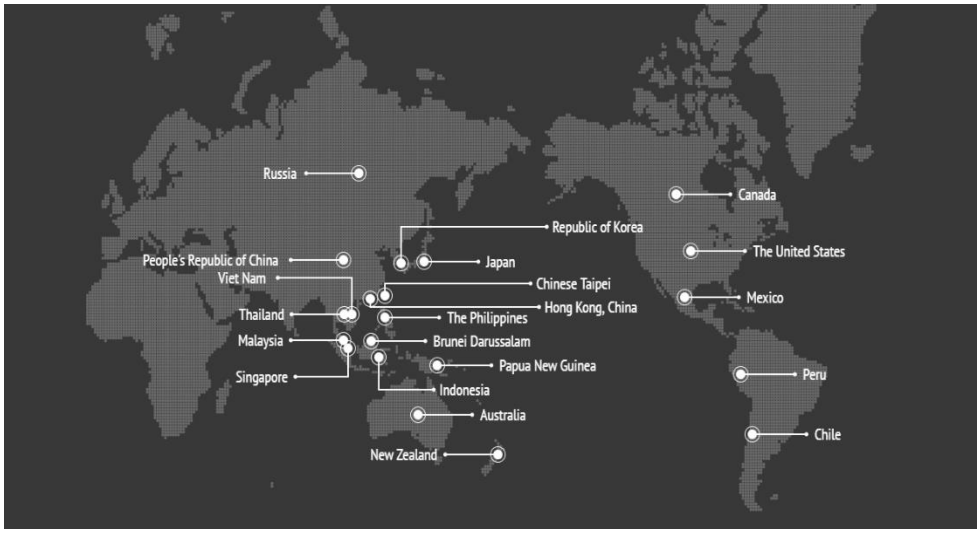
The way ANT work is tracing the actor or continuously extracting how an actor is defined by its relations within a network: the thoughts, feelings, actions, and identities (Boelens, 2010; Latour, 2005; Sage et al., 2011). The contribution of ANT to understand phenomena is based on its ability to draw socio-material relations in the arrangement of orders and hierarchies and to define how the temporarily stable relationships of 'actor network' can deliver certain meanings, actions, and solutions (Farías, 2011; Yvonne Rydin, 2012). ANT analytical process comprises of four stages, which are problematization, interessement, enrolment, and mobilization (Kadia Georges Aka, 2019; Yvonne Rydin, 2012). Problematization is a stage of framing problems (Yvone Rydin & Tate, 2016). Interessement is a stage of identifying actors and establishing the networks where the obligatory passage point emerged as its center (H. W. Chen & Lin, 2018). Enrolment is a stage of strengthening the networks by expanding more actors into network and define their roles (Yvone Rydin & Tate, 2016). Mobilization is a stage of stabilizing and destabilizing of the networks (Yvone Rydin & Tate, 2016).

Asia Pacific and ASEAN

Asia Pacific refers to the area that covers the Pacific Rim region. For clarity of definition, in this study the Asia Pacific was narrowed down to the countries

incorporated in Asia-Pacific Economic Cooperation (APEC) which included 21 countries members (figure 1) from North America, South America, ASEAN, East Asia, Russia, and Oceania (APEC, 2019). This area is the most dynamic area in the global economy, with considerable margins, covering almost two-third of the world economic growth (IMF, 2018).

Figure 1. Asia Pacific Economic Cooperation member economies



Source: www.apec.org

The ASEAN Association is a prominent part of APEC (Yates & Beeson, 2019). ASEAN consists of Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam (ASEAN, 2019). ASEAN is an area that includes more than 500 million people with GDP of more than US $ 700 billion (ASEAN, 2012). This area has a strategic location in the world geopolitics, abundant natural resources as well high potential of quality and quantity of human resources (Prakash & Isono, 2012).

Methodology

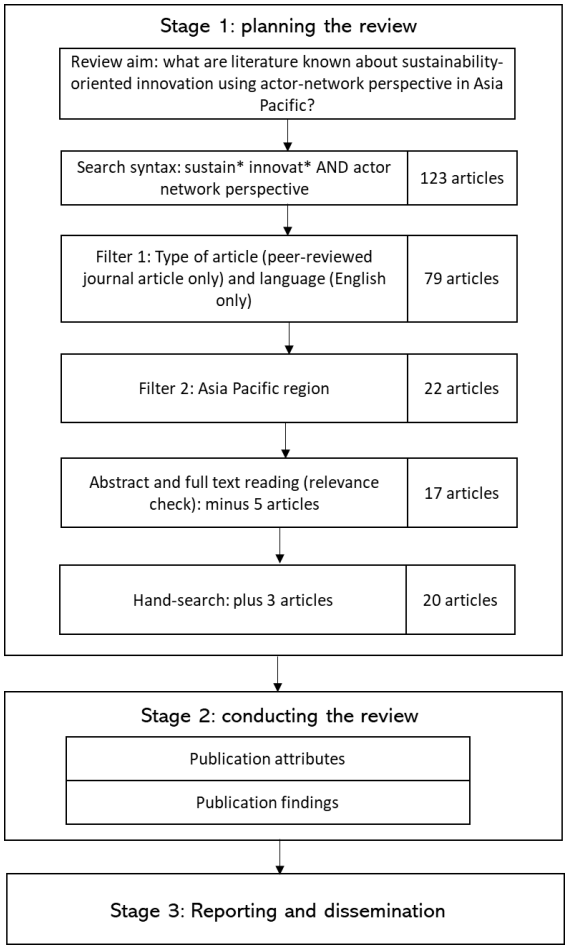
In conducting a systematic review we followed the Tranfield et al.'s (2003) protocol which described three stages in a systematic review including: (1) planning the review, (2) conducting the review, and (3) reporting and dissemination (figure 2).

In the first stage, planning is carried out through dialogue among the author team to determine the research scope through articulation of review questions, and criteria for exclusion and inclusion. By considering various aspects that have been explained in the introduction section, the specific review question raised in this review are: what literature known about sustainability-oriented innovation using actor network perspective in Asia Pacific?

Our strategy is to search for peer-reviewed literature in the academic database of Scopus which is the largest

peer-reviewed database today. The search syntax that we use is: "sustain* innovate*" which reflects the concept of SOI and combines it with "actor network perspective" or "actor network theory" that reflects the concept of actor network perspective. This comprehensive search generates 123 articles form the database.

Figure 2. Systematic review process



The criteria of inclusion/ exclusion for the specified filtering process is the publication type, language, and region. For the year of publication, we did not set specifically so that the timespan in this review is open from any year up to May 2019. The type of publication chosen is empirical peer-reviewed articles because what we are looking for is research that has been successfully published after passing the peer-reviewed process. Conference proceedings, reviews, chapters and other types of publications are excluded because of these criteria. Furthermore, for language, we only included English-language articles considering this is the main language in publications for international audiences. Filtering by type of publication and language resulted in 79 articles.

For region filtering, we use screening feature in the database by limiting searches to the members of APEC as listed earlier in the Asia Pacific and ASEAN section. At this stage the search results in 22 articles. After that we filter the relevance by reading the title, abstract and full text to ensure the relevance of the article for the purpose of our review. From this screening process 5 articles were excluded for several reasons. First is the type of publication that is theoretical not empirical. Although we have filtered the database from the beginning by restricting searches to empirical peer-reviewed articles, we found this filtering was not 100% perfect and still allowed other types of publications to be included in the search results. The second reason is relevance to SOI and actor network perspective, and the third is the focus region not in the Asia Pacific region. So that at these stage 17 articles were obtained. After that, as a supplement, we did hand-search yang which produces 3 articles. This strategy is as the previous researcher did to supplement the systematic review (e.g. Adams et al., 2016). At these stage 20 articles were

obtained, which became the final results to be analyzed in more depth.

The analysis was carried out on two aspects of the article namely attributes and findings. By attribute, we analyze it using descriptive statistics to find out the publication outlets, years of publication, and country focus in publications. We also identified the types of organizations that were the focus of those studies. Visual display of figure and tables are provided to help understand the attributes of a publication included in this review.

20 articles from the previous stage were then reviewed based upon their methodological approaches to identify 'network complexities' within the SOI projects. On each article, we focused on understanding how various frameworks and methods were used systematically to explain meanings, structures, characteristics, aims, and strategies of actors within SOI projects. In addition, we also analyzed how the frameworks and methods were performed to assess strength and weakness as well as success and fail of SOI projects in both individual and comparative ways.

Having done the above reviews, we identified the most method used and identified how the method is contributed into SOI project's analyses. In doing this process, we firstly classified the 20 articles into a table linking information such as author, title, methods, and findings. Based on tabulation results, we justified the most used method and began to summarize the works and findings of such methods in their article.

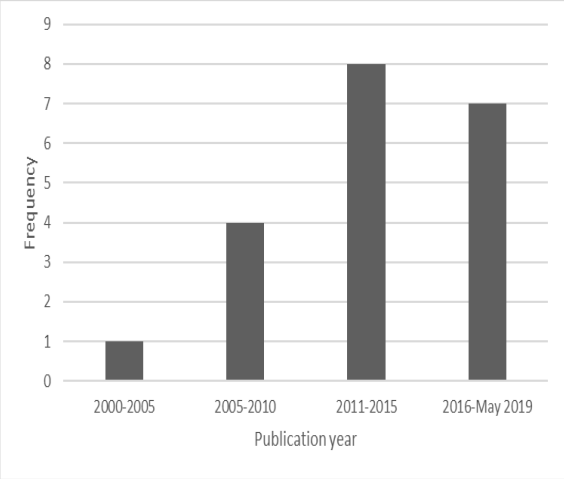
Based on the summary of works and findings, we concluded several roles of the network method in more detail way. In this regard, we explained the roles using general terms instead of actual terms presented in the reviewed articles. For instance, in explaining the role of a method in defining SOI in an article with tourism and transport context, we used the term 'policymakers' instead of Tourism Agency (in tourism context) or Ministry of Transport (in transport context). Finally, to support our explanation, we borrowed a simple SNA (Social Network Analysis) illustration figures comprising of symbols such as circle referring the actors and line referring the network or interaction (Caniglia et al., 2016; Yvonne Rydin, 2012). However, our illustration figures do not represent any quantitative result analysis, and instead, they are simple unweighted figures to show distribution, composition, and linkage of actors. The size of symbol does not refer to any quantitative measurement.

Results & Discussion

Most articles included in this review, three-quarters, are published in the last decade signify the increasing study of SOI using actor network perspective (figure 3). These articles are published in journals in different fields indicate the multidisciplinary nature of SOI using actor perspective. These journals include: Journal of Cleaner Production (2 articles), Sustainability

(Switzerland) (2), Ecology and Society (1), Regional Environmental Change (1), Frontiers in Public Health (1), Environmental Education Research (1), Administrative Science Quarterly (1), Maritime Policy and Management (1), Journal of Sustainable Tourism (1), Journal of Marketing (1), Language Learning and Technology (1), Research Policy (1), Energy Policy (1), Accounting (1), Auditing and Accountability Journal (1), Technovation (1), Progress in Planning (1), and Rural Sociology (1).

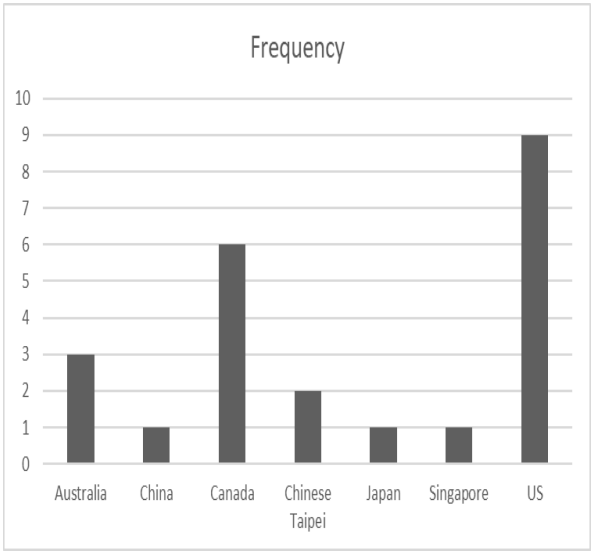
Figure 3. Publication year



Regionally, the focus of the study so far is in North America while studies in ASEAN are still very limited

For country focus (figure 4), the study of SOI using actor network perspectives so far in conducted in seven economies context includes Australia (3 articles), China (1), Canada (6), Chinese Taipei (2), Japan (1), Singapore (1), and US (9). Most of the studies (18 out of 20) were conducted in single-country focus and the remainder was done with multi-country focus. From this profile it is known that almost all of these studies are in advanced economies setting (except China). The focus of the study, regionally, mostly (around three-quarters) are in North America (US dan Canada). Studies in ASEAN context are still very limited, so far only done in Singapore context.

Figure 4. Country focus



From sustainable rural agriculture to 'environmentally-friendly' cycling: The dynamic implementation of SOI using actor network perspective

The type of organization studied in the articles reviewed is diverse ranging from business organizations, community, city, governmental, school, university, particular industry, region, and rural agriculture. To analyze findings from these articles, we classify them into two implementations focus, namely profit and nonprofit (table 1). If a study is multi-implementation, for example a combination of business-community, we categories it based on the emphasis. If its emphasis on profit organization, we include it in profit and vice versa.

Table 1. Implementation focus

Implementation focus	Author and Year
Profit (business or industry) or mixed with emphasize on profit organization.	(Aka, 2019), (Tatarynowicz, Sytch, & Gulati, 2016), (Acciaro et al., 2014), (Albrecht, 2013), (Giesler, 2012), (Garud & Gehman, 2012), (Stephens & Jiusto, 2010), (Caron & Turcotte, 2009), (Johnson, 2008), (Tseng, Chiu, Tan, & Siriban-Manalang, 2013), (Tseng, Wang, Chiu, Geng, & Lin, 2013), (Lin, Tan, & Geng, 2013)
Nonprofit (community, city, region) or mixed with emphasize on nonprofit organization.	(Parlee & Wiber, 2018), (H. W. Chen & Lin, 2018), (Mallett & Cherniak, 2018), (McCalman, Bainbridge, Brown, Tsey, & Clarke, 2018), (Lynch, Eilam, Fluker, & Augar, 2017), (Hinkelman & Gruba, 2012), (Holden, 2008), (Milton, 2003), (Tang, Chen, & Chiu, 2018)

Building the understanding of the dynamic of SOI implementation through network perspective: The emerging role of Actor-network Theory (ANT)

From the following table 2, our review has found 14 articles (nearly 70% from the total article reviewed) applied Actor-Network Theory (ANT) as both analytical method, discussion framework, and logic of description. Linking to the characteristic of ANT as a flexible and adaptive method, our review found that ANT was applied into various analytical process in such articles. Most articles applied a general analytical process of ANT such as defining the networks and highlighting the process through four ANT's stages. Nevertheless, some others borrowed ANT's philosophy and logic to be diffused into other analytical platforms such as Social Network Analysis (SNA) (Albrecht, 2013), (2) Obligatory-Passage Point (H. W. Chen & Lin, 2018), and (3) Analytical Network Process (ANP) (Tseng, Wang, et al., 2013).

Table 2. Network method applied

Method	Author and Year
Actor Network Theory (ANT)	(Kadia Georges Aka, 2019), (Lynch et al., 2017), (Giesler, 2012), (Hinkelman & Gruba, 2012), (Stephens & Jiusto, 2010), (Caron & Turcotte, 2009), (Milton, 2003), (Tang et al., 2018)
'ANT-diffused' method	(H. W. Chen & Lin, 2018), (Albrecht, 2013), (Garud & Gehman, 2012), (Johnson, 2008), (Holden, 2008), (Tseng, Wang, et al., 2013)
Other Methods	(Parlee & Wiber, 2018), (Mallett & Cherniak, 2018), (McCalman et al., 2018), (Tatarynowicz et al., 2016), (Acciaro et al., 2014)

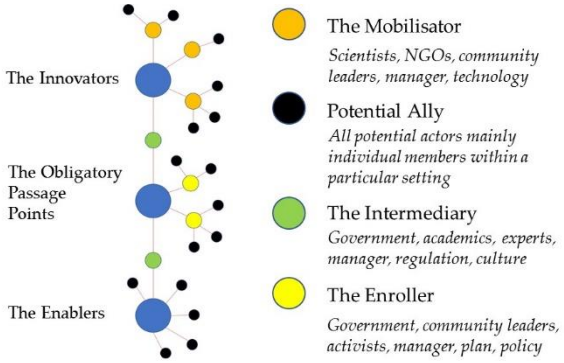
From articles that applied ANT for their research, we have found that, at least, ANT contributed in three roles in SOI research. First, ANT contributed in explaining the structure and composition of actors in SOI projects. Second, ANT contributed in analyzing SOI mobilization, progress, and change based on network changes. Third, ANT contributed in

assessing the strengths, weaknesses, potentials, and challenges of several alternative SOI projects. The explanations of these are presented as follows:

ANT for analyzing structure and composition of actors in SOI network

In this role, ANT described the interaction processes of certain networks of SOI projects and then derived all possible actors in the networks and discussed their roles, responsibilities, and relationship each other. For instance, Aka K. G. (2019) explained the development of SOI from conventional bikes to electric mechatronic and then hybrid bike. ANT was used to extract the actors and identify their role, which came into findings that from more than 20 actors ranging from policymakers to employees that establishing a complex system of developing SOI for hybrid bike, the manager of hybrid bike company and researcher played the most important role to developing and maintaining SOI project. In other case, Lynch et al (2017) studied that SOI in learning process was implemented through the logic of multiple realities as an opportunity to learn about the environment. The used of ANT emphasized several possibilities of SOI project going into different meanings and impacts for different actors due to their 'background'. This confirmed the nature of SOI as a complex project built upon 'multi-perspective' of the involved actors. The following figure 5 illustrates the process of ANT describing the structure of actors and their roles within SOI projects compiled from all article cases.

Figure 5. Understanding the networks



ANT for analyzing mobilization, progress, and change of SOI project

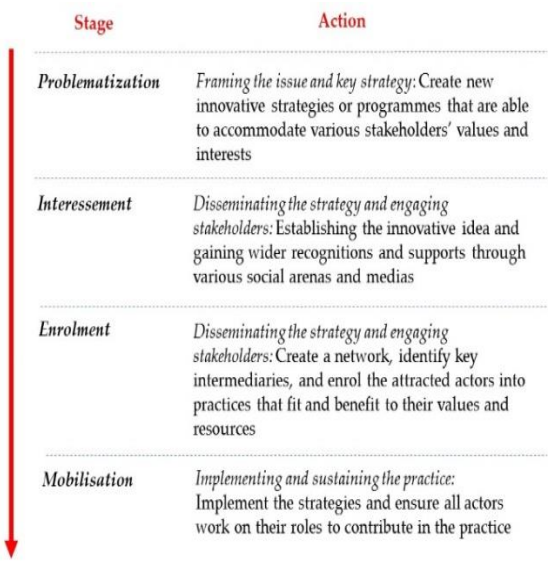
In this role, ANT analyzed the process of SOI following the dynamic changes and interactions between actors. This includes how the project being mobilized from the beginning to an end, how the project going into a particular direction, and how the project is slowly transformed and improved.

For instance, Albrecht (2013) discussed the process of implementing SOI in tourism development in a particular area was determined by the changing of values, roles, interests, and power of actors involved in all stages of the process. His ANT research highlighted that certain actors in the network continuously shared roles and values in problematization, interssement, and enrolment, such as public sector that switched roles with private company to provide financial and regulatory support or public sector and tourism group that change position as a mediator for all other stakeholders in the network including community, service providers, and many others. This situation, where power is openly distributed to several actors, has

been described as a key important factor that maintaining the continuation of innovation.

Meanwhile, Giesler (2012), against the backdrop of rapid changes of nature and technology innovations, assessed the overall process of promoting SOI in cosmetic industries. In his study, ANT was used to learn how the innovation process was comprehensively organized from branding to selling activities with attempts to revitalize the brand image in the upstream as well as the change of consumer behaviors in the downstream. The ANT analysis has identified that the most important step determining a whole success of the implementation of innovation lied in the enrolment process involving experts and their research outputs and engagements. Again, using an illustrative figure, this research summarizes the general process of mobilizing SOI through the lens of ANT based on several reviewed articles with relevant discussions (figure 6).

Figure 6. Understanding the process



Comparing SOI projects using ANT

ANT contributed in assessing the strengths, weaknesses, potentials, and challenges of several alternative SOI projects. This role is important for SOI's enablers or initiators especially when they want to maintain, develop, and select a particular SOI project with regard to other alternative projects due to various constraints such as financial, technological, knowledge, and human resource. This research found that Stephens and Jiusto (2010) provided a useful insight of the uses of ANT in analyzing several SOI project alternatives for further intervention purpose. Their study concerned on the examination of the effectiveness of two SOI projects, the carbon capture and storage (CCS) and enhanced geothermal system (EGS), to reduce greenhouse gas emissions from electrical power generation in the United States. By focusing on several indicators such as technical, environmental, financial risk, and benefit of each system which were discussed through the ANT logics, their study found that social and political dimensions such as involvement, engagement, and association of involved stakeholders became the most important aspects determining the success of two SOI projects. The success, in this regard, was defined by the likelihood of a particular project to enhance wider technical, environmental, and financial support so they can be maintained in the long-run. ANT analysis was able to suggest that the CCS project, with its stronger and wider network engagement in comparison to the CGS, had

successfully established a more sustainable innovation program with large technological, regulatory, and financial arrangement supports.

Conclusion

Having through all the review process, our paper summarizes several important findings from the study of understanding SOI in Asia Pacific and ASEAN through Network perspective. This is presented in four conclusion points as follows:

1) SOI has been rapidly developing into practices in countries in Asia Pacific, which not only in profit sectors, but also in non-profit sectors such as government and community.

2) Actor-network Theory (ANT) emerged as the current-most adopted framework to explain the dynamics process of SOI mobilizations and practices in the Asia Pacific region.

3) ANT frameworks contribute in defining the structure of SOI networks as well as identifying social, institutional, and political challenges of SOI implementation.

4) Regionally, the focus of the study so far is in North America (US and Canada) while studies in ASEAN are still very limited (only Singapore so far).

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